PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:
Nikoonahad et al.

Serial No. 10/670,183

Filed: September 24, 2003

For: METHODS AND SYSTEMS FOR DETERMINING A CRITICAL DIMENSION AND A THIN FILM CHARACTERISTIC OF A SPECIMEN

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Group Art Unit: 2863
Examiner: Washburn, Douglas N.

Atty. Dkt. No. 5589-02326 P688-04C

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1/10/06 Pamela Gerik
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REPLY BRIEF TO EXAMINER'S ANSWER

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
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Dear Sir/Madam:

This paper is submitted in reply to the Examiner's Answer mailed November 18, 2005. Appellant respectfully requests that the Board consider this Reply Brief, which is presented within two months from the date of the Examiner's Answer thereby complying with 37 CFR § 41.41(a)(1). This Reply Brief does not include any new or non-admitted affidavit or other evidence thereby complying with 37 CFR § 41.41(a)(2).

The Examiner's Answer maintains the 35 U.S.C. § 102 rejections of claims 6633-6651. The Examiner's Answer appears to raise new points of argument on pages 7-14, in Section 10 "Response to Argument," which are addressed in detail herein.

With regard to claims 6333-6634, 6636-6637, 6642, and 6645-6647, the Examiner's Answer states:

> Appellant defines a critical dimension as...'may also include a lateral dimension of a feature defined in a direction substantially perpendicular to an upper surface of the specimen such as height of (a) feature on (a) specimen'...Examiner interprets height of a feature...thickness...[as] A layer, sheet, stratum, or ply) on a specimen as a determination of the thickness of the layer or substrate and as such comprises a critical dimension as defined by the appellant." (Examiner's Answer -- page 7 and pages 12-13, emphasis in original).

The Examiner's Answer also states that "Examiner interprets determination of the thickness of a layer or substrate as such comprises a critical dimension as defined by the appellant." (Examiner's Answer -- page 8).

Although a critical dimension of a feature may be a height or thickness of a feature, a layer formed on a substrate or a substrate itself is not a "feature" as the term is used in the Specification and is known by those of ordinary skill in the art. For example, the Specification states:

> As shown in Fig. 8, a plurality of features 56 may be formed upon upper surface 58 of specimen 60. For example, features formed on an upper surface of the specimen may include local interconnects, gate structures such as gate electrodes and dielectric sidewall spacers, contact holes, and vias. The plurality of features, however, may also be formed within the specimen. Features formed within the specimen may include, for example, isolation structures such as field oxide regions within a semiconductor substrate and trenches. (Specification -- page 74, lines 10-17).

In addition, in the Handbook of Silicon Semiconductor Metrology, Alain C. Diebold, New York, New York, Marcel Dekker, Inc., 2001, on p. 377, a copy of which was submitted with the Supplemental Appeal Brief filed by Appellant on April 4, 2005, M. Cresswell et al. state that "Usually, test patterns include features that have drawn linewidths matching the minimum of the features being printed in the circuit. These linewidths are typically referred to as the process's *critical dimensions* (CDs)." (emphasis in original).

Therefore, a "feature" as described in the Specification and as commonly known in the art does not include an unpatterned layer formed on a substrate or an unpatterned substrate itself. In other words, a feature as described in the Specification and as commonly defined by those of ordinary skill in the art is a structure that is part of a pattern formed on a substrate. In this manner, an unpatterned layer or an unpatterned substrate contains no features. Although the claims recite a "critical dimension" instead of "a critical dimension of a feature," it will be clear to one of ordinary skill in the art based on the description of the invention provided in the Specification and the common use of the term "critical dimension" that the recitation of a "critical dimension" in the claims means a "critical dimension of a feature." Therefore,

it will be clear to one of ordinary skill in the art, that a "critical dimension" as recited in the claims does not include a thickness of a layer formed on a substrate or the substrate itself.

As set forth in the Supplemental Appeal Brief filed by Appellant on April 4, 2005, Aspnes and Stanke disclose determining a film thickness. However, neither Aspnes nor Stanke teaches that the film is patterned or contains features. Therefore, neither Aspnes nor Stanke teaches determining a thickness of a feature. Consequently, Aspnes and Stanke do not teach determining a critical dimension of a specimen from output signals generated by a spectroscopic ellipsometer, as presently claimed, when the term "critical dimension" is assigned a meaning based on the description of the invention provided in the Specification and common knowledge in the art. As such, contrary to the assertions in the Examiner's Answer, the cited art does not teach all limitations of claims 6333-6634, 6636-6637, 6642, and 6645-6647.

With regard to claims 6635 and 6649-6650, the Examiner's Answer states:

> 'The processor 48 receives the output of the detector arrays 54/56, and derives the thickness and refractive index of the thin film layer 8 based on these angular dependent intensity measurements by utilizing various types of modeling algorithms.' (column 4, lines 58-62) which examiner interprets as teaching a system that is configured to determine at least two properties of a specimen and that is integrated into a process tool. (Examiner's Answer -- page 9).

However, processor 48 is not a process tool. In addition, no other portion of the teachings of Aspnes referred to in this portion of the Examiner's Answer discloses a process tool. Therefore, Aspnes does not teach a system that is configured to determine at least two properties of a specimen and that is integrated into a process tool as contended in the Examiner's Answer. Consequently, Aspnes does not teach all limitations of claims 6635 and 6649-6650.

With regard to claims 6638-6641 and 6651, the Examiner's Answer states that "The probe beams 24/26 are reflected by mirror 30, and pass through mirror 42 to sample 4.' (see column 3, lines 45-61; figure 1, elements 20, 22, 24 and 26) wherein examiner notes probe beams 24 and 26 are impinging specimen surface at a normal angle of incidence." (Examiner's Answer -- pages 10 and 12, emphasis in original). However, Aspnes does not teach that probe beams 24 and 26 are used by the spectroscopic ellipsometer. In particular, Aspnes teaches that broadband spectroscopic ellipsometer 18 includes polarizer 70, focusing mirror 72, collimating mirror 74, rotating compensator 76, analyzer 80, spectrometer 58, and processor 48. (Aspnes -- col. 5, line 41 to col. 6, line 10). In addition, as shown in

Fig. 1 of Aspnes, focusing mirror 72 of the spectroscopic ellipsometer does not focus probe beams 24 and 26 on the sample. Instead, Aspnes states that "Mirror 72 focuses the beam onto the sample surface at an oblique angle, ideally on the order of 70 degrees to the normal of the sample surface." (Aspnes -- col. 5, lines 49-52). Furthermore, Aspnes does not teach that the configuration of the spectroscopic ellipsometer can be altered such that the focusing mirror directs light onto the sample surface at a normal angle of incidence or such that the spectroscopic ellipsometer performs measurements using probe beams 24 and 26. As such, contrary to the assertions in the Examiner's Answer, Aspnes does not teach all limitations of claims 6638-6641 and 6651.

With regard to claim 6643, the Examiner's Answer states:

> Aspnes teaches 'The processor 48 receives the output of the detector arrays 54/56, and derives the thickness and refractive index of the thin film layer 8 based on these angular dependent intensity measurements by utilizing various types of modeling algorithms.' (column 4, lines 58-62; figure 1, element 48) which examiner interprets as teaching a processor that is configured to use a thin film characteristic of a specimen to determine a critical dimension of the specimen. (Examiner's Answer -- page 10).

As noted above, however, Aspnes teaches that spectroscopic ellipsometer 18 includes polarizer 70, focusing mirror 72, collimating mirror 74, rotating compensator 76, analyzer 80, spectrometer 58, and processor 48. (Aspnes -- col. 5, line 41 to col. 6, line 10). Aspnes also teaches that detector arrays 54 and 56 are included in beam profile reflectometer 12. (Aspnes -- col. 4, lines 35-40). Therefore, detector arrays 54/56 are not included in the spectroscopic ellipsometer of Aspnes. As such, output signals generated by detector arrays 54/56 are not output signals generated by the spectroscopic ellipsometer of Aspnes. Consequently, Aspnes does not teach using a thin film characteristic of a specimen determined from one or more output signals generated by a spectroscopic ellipsometer to determine a critical dimension of the specimen, as recited in claim 6643. Therefore, contrary to the assertions in the Examiner's Answer, Aspnes does not teach all limitations of claim 6643.

With regard to claim 6644, the Examiner's Answer states:

> FIG. 1 illustrates the composite optical measurement system 1 that has been developed by the present assignees, which includes five different non-contact optical measurement devices and the reference ellipsometer 2 of the present invention.' (column 3, lines 33-44; figures 1 and 4) which examiner interprets as teaching a system configured to determine at least two properties of a specimen that is coupled to a stand-alone metrology or inspection system. (Examiner's Answer -- page 11).

However, Aspnes teaches that all of the non-contact optical measurement devices and reference ellipsometer 2 are included in optical measurement system 1. (Aspnes -- col. 3, lines 40-44). Therefore, all of the measurement devices and the reference ellipsometer are included in a single system. As such, the measurements devices and the reference ellipsometer are not included in two different systems. In this manner, the measurement devices and the reference ellipsometer cannot be included in a first system, which is configured to determine at least two properties of a specimen, and a second system, which is coupled to the first system and is a stand-alone metrology or inspection system. Consequently, contrary to the assertions in the Examiner's Answer, Aspnes does not teach all limitations of claim 6644.

With regard to claim 6648, the Examiner's Answer states:

> Aspnes teaches 'The advantage of the present invention is that a reference sample having no film thereon, or having thin film thereon with an unknown thickness which may even vary slowly over time, can be repeatedly used to accurately calibrate ultra-sensitive optical measurement devices.' (column 9, lines 61-65) which the examiner interprets as a specimen comprising a substrate suitable for fabrication of a reticle. (Examiner's Answer -- page 11).

However, Aspnes does not teach that the reference sample is or can be a substrate suitable for fabrication of a reticle. In addition, the reference sample disclosed by Aspnes is not inherently a substrate suitable for fabrication of a reticle. Therefore, contrary to the assertions in the Examiner's Answer, Aspnes does not teach all limitations of claim 6648.

CONCLUSION

For all of the above reasons, and for reasons clearly stated in Appellant's Appeal Brief, it is believed that the claims are patentable. Appellant respectfully requests that the Board of Patent Appeals overturn the Examiner's rejections.

Respectfully submitted,

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